and in Schreiber's[3] compilations to which I am chiefly indebted for the accompanying data. The original papers are enumerated therein, and the bibliography need not be repeated in this place.

Table 62, formulas 55 to 65, contains the summary of values of $k$, together with a brief statement regarding the nature of the experiments and the fundamental formulas of the instrumental work. Formula 55 gives Maxwell's value of the coefficient of viscosity in British units and in C. G. S. units, with reference to Basset's Hydrodynamics. Formula 56 gives Poncelet and Unwin's equation, which takes account of the contraction and expansion of the stream lines in passing by a body. Formula 57 gives the equation for transforming the pressure on a body moving rectilinearly into that encountered by it when carried on a whirling machine. The group of equations under formula 58 contains Hagen's results in (C. G. S.,) (K. M. S.), and (P. F. S.) units, respectively. It is to be observed that a considerable factor depends upon the circumference of the plates, and that the value of $k = 1.104$, when the circumference is very small, as in raindrops. Formula 59 contains the result of Thiessen's and Schellbach's experiments on long cylindrical rods whirled by a machine, and it shows that there is a complex function depending upon the first and second powers of the velocity which is involved in the coefficient of resistance. Formula 60 gives the equation for equilibrium in Dines's machine, which has a special device for determining the pressure (fig. 38). The rectangular arm $P\,B\,W$ is rigid and rocks upon the axis $B$; the arm $B\,W$ is stayed between two stops, with electric contact, so that the length of the working arm for $W$ can be accurately adjusted to the whirling pressure $P$ on the plate $A$. Formula 61 gives the equation for $k$ and the accompanying table of values for $\lambda$ and $k$. $\lambda$ is the coefficient required to find the pressure in pounds per square foot from the velocity in miles per hour, and it averages $\lambda = 0.00355$, which appears in formula 62, $\Delta p = 0.00355\,v^2$. Professor Marvin has established the value for the Weather Bureau $\lambda = 0.00400$, from which $\Delta p = 0.00400^2$. Professor Nipher has determined the value $\lambda = 0.00251$ on the windward side alone, so that from Irminger's experiments we are safe in taking the total value as that given by Dines or Marvin for general conditions. The result of Stokes's investigation on the resistance of any moving body immersed in a fluid shows that it consists of two parts, the first due to viscosity proportional to the velocity, and the second due to the gyratory motions which are generated in the fluid under the existing conditions, proportional to the square of the velocity. Formula 63 gives Stokes's equation and the value of $\mu$ for air, with a velocity $v$ in inches per second. There are, however, other methods of determining the viscosity which are considered better, referred to in 55. Formula 64 gives the maximum velocity of a falling body when it has become uniform, with an example for a raindrop in the air. Since the pressure on a large plate varies between the center and the edge by certain laws to be discovered by experiment, the distribution of the pressure has been discust by Recknagel, Schreiber, and Nipher. Formula 65 contains Recknagel's equation for any velocities, the terms being specified. For Schreiber's and Nipher's results reference may be made to their papers.

It will be seen by inspecting the catalog of values for $k$, the coefficient of resistance to a rigid body moving in air, since the water experiments have not been included in the list, that there is a great diversity of data to be considered in selecting a mean value. This arises from the great variety of conditions involved in the investigations, and also from the great length of time covered in the researches, about 100 years. At the same time it is evident that they average closely to the value assigned by Schreiber, $k = 1.30$. This value applies generally to rather large objects, plates, disks, and solids having a normal sectional area of one square foot or more. For small bodies, such as drops of rain or even hailstones, I am inclined to believe that Ferrel's value of $k$ is nearly correct, that is $k = 1.10$. The uncertainty, however, is such that it must be left to the investigator to make his choice as to the adopted value. Consequently in Table 56 I have kept the value of $k$ apart from the section containing the vertical velocity $w$. If we choose for hailstones an average diameter of one centimeter, I suppose that nine-tenths of the value of $w$ given in the column under 273 at the several heights is about what may fairly be expected as the sustaining velocity in meters per second up to a height of 8000 meters. That is, the value of $w$ at the freezing temperature and the height at which hail forms is as in the following table:

TABLE 65.—*Probable sustaining vertical velocities, w, for hailstones.*

| Height. | Probable sustaining velocity. | |
|---|---|---|
| | For common hailstones. | For very large hailstones. |
| *Meters.* | *M. per s.* | *M. per s.* |
| 0 | 12.8 | 25.6 |
| 1000 | 13.6 | 27.2 |
| 2000 | 14.4 | 28.8 |
| 3000 | 15.3 | 30.6 |
| 4000 | 16.2 | 32.4 |
| 5000 | 17.2 | 34.4 |
| 6000 | 18.3 | 36.6 |
| 7000 | 19.3 | 38.6 |
| 8000 | 20.5 | 41.0 |

[3] Studien über Luftbewegungen, von Paul Schreiber, Adh. d. Kön. Sächs. Met. Inst. Heft 3, Chemnitz, 1898.

## FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

From September 30 to October 3 a severe storm advanced from the Azores over the British Isles and northwestern continental Europe, attended on October 2 and 3 by disastrous gales on the French and British coasts. On the morning of September 30 the following was cabled to Lloyds, London: "Severe storm south of Azores will probably move northeastward". Pressure continued low over the British coasts, except on the 25th and 27th, with marked barometric depressions on the 15th, 22d, and from the 28th until the close of the month. The depression of the 28th–31st continued during the early days of November, covered western Europe, and caused storms as far south as the Mediterranean. The center of a severe storm that passed near the Azores on the 18–19th crost the British Isles on the 22d. During the period of low barometric pressure over the British coasts, and especially from the 28th until the end of the month and during the first days of October, the barometer continued high over the eastern half of the United States, with attending fair and cool weather. Over the western half of the United States this period was marked by a succession of depressions of slight intensity that were attended by unsettled and rainy weather, with snow in the mountain districts and the Northwest.

In the United States the first important storm of October advanced from the north Pacific coast to the Canadian Maritime Provinces from the 1st to the 7th, and on the morning of the 7th a barometric pressure of 28.68 inches was reported at its center. The area of high pressure that followed this storm moved from the north Pacific coast to the Gulf States and

thence northeastward off the Atlantic coast, and in its front the first snow of the season occurred at points in eastern Colorado.

The period from the 19th to 23d was stormy in the middle Rocky Mountain districts. In Denver and Cheyenne the depth of snowfall was nearly two feet, and in the mountains of Colorado and north-central New Mexico snow fell to a depth of six to thirty-six inches. The snowstorm extended from this region over South Dakota, western Nebraska, western Kansas, the Texas panhandle, northern Arizona, and Utah. In Utah a severe windstorm set in during the night of the 20th and continued on the 21st, causing considerable damage. At Salt Lake City a maximum velocity of 52 miles an hour from the northeast was registered. Snow fell in the upper Lake region on the 29th, and a heavy fall of snow occurred in western and northern New York on the 30th and 31st. Following the passage of the low area (VII) that contributed to the storm period referred to, frost occurred in the interior of the Southwestern States from the 23d to 25th.

The following from Mr. C. P. Horton, Bourne, Mass., refers to a special frost-warning service that has within the last two years been in operation in the cranberry district of Massachusetts:

I have to thank you, in common with all the growers of cranberries in this section, for your timely warnings of frost, which in one case at least saved us from serious loss. I consider the service of the Bureau is of very great value to the growers of the principal crop here.

Attending an area of low barometer that moved northeastward from the Gulf of Mexico during the 5th, a small tornado past over the western portion of New Orleans about 9:30 a. m. of that date, injuring several persons and causing some damage to property.

THE WEST INDIAN HURRICANE OF THE SECOND DECADE OF OCTOBER, 1906.

This storm apparently had its origin over the eastern Caribbean Sea early in the second decade of the month, and drifted westward as a shallow barometric depression that covered practically the entire West Indian-Caribbean Sea region.

On the morning of the 17th, reports indicated the presence south of western Cuba of a well-defined cyclonic disturbance, and at 11 a. m. of that date storm warnings were ordered on the east Gulf, Florida, and south Atlantic coasts, and the following was telegraphed to Atlantic and Gulf ports and to Havana, Cuba: "* * * Disturbance apparently approaching western Cuba from the Caribbean Sea. Unsafe for vessels next few days off western Cuba, Florida, and south Atlantic coasts".

The center of the storm past near and east of Havana at 11:30 p. m. of the 17th, with minimum barometer, at Havana, 28.86 inches, and by the morning of the 18th, had reached a position near and to the eastward of Key West, where at 3 a. m., a minimum barometric reading of 29.30 inches was registered. Moving thence northeastward to a point about opposite the South Carolina coast the center recurved to the westward, and was then forced southward over the Florida Peninsula by an area of high barometer that covered the north Atlantic coast districts.

Senor Luis G. Carbonell, Chief of the Meteorological Service of Cuba, reports that in its passage over Cuba the storm was of great intensity, small diameter, and rapid march, and that its force extended to the west as far as Pinar del Rio, with strong winds from the north to northwest, and to the east about as far as Cardenas; that great damage was not caused in the provinces of Matanzas and Pinar del Rio, but that in the Province of Havana there was great destruction of cane, trees, and all plants in general. In the city of Havana there were some fatalities caused by the falling of houses that were in bad condition.

The following report of the storm is made by Mr. F. E. Hartwell, Assistant Observer, Weather Bureau, Key West:

Storm warnings ordered and advices received 11:35 a. m., 17th. Wind gradually increased, and backed from east to northeast at 6 p. m., where it held until after midnight. Barometer fell steadily after 6 a. m., and at midnight stood at 29.45 inches. Up to midnight the wind velocity did not exceed 30 miles an hour. About 3:30 a. m., of the 18th, the wind backed to north, and by 4:30 a. m., to northwest. The barometer fell until 3 a. m., with minimum reading 29.30 inches. The center of the storm past very near and southeast of the station. At Sand Key the lowest reading was about 29.25 inches, and wind velocities as high as 75 miles an hour were recorded at that station. The highest velocity at Key West, 54 miles an hour, occurred at 7:20 a. m., of the 18th.

Every effort was made to give the warnings the widest possible circulation, and little damage was done on the island. Among the small boats in the harbor those taking precautions escaped, but others suffered considerable damage, and some were destroyed by pounding against the docks. The Revenue cutter *Fessenden* was the only large vessel that received injury in this port. The Mallory steamer *Concho* remained in port about forty-eight hours, and the Peninsula and Occidental steamers *Mascotte* and *Miami* were held for a considerable time. The progress of the storm up to the keys was marked by very high water, which, with the wind, caused much destruction of property. The quarter boats of the East Coast Extension were carried out to sea and many lives, probably more than 100, were lost. Forty-nine men were picked up by the Austrian steamer *Jenny* and returned to Key West, 24 were landed at Savannah, Ga., and a number were picked up by other steamers.

Mr. Dan Ross, master of the tug *Sybil*, moored at Miami, Fla., furnishes the following extract from his log:

October 17.—Got ready for sea at noon, but as northeast storm warnings were displayed, had orders to wait developments. October 18.—4 a. m., northeast gale blowing, with much rain. Barometer falling rapidly. At 9:30 a. m. wind died out, and lowest barometer (28.55 ?) was noted. The calm lasted about thirty minutes, then came on a blow from the northwest, backing to west-northwest and blowing very hard until noon, when it began to abate, and by night the gale had ceased.

Mr. H. P. Hardin, Observer, Weather Bureau, Jupiter, Fla.:

No damage resulted in this vicinity, as the warnings had caused measures of protection to life and property before the storm reached here. At the extreme southern end of the State where the Florida East Coast Railway Company is building its line over the keys and water into Key West, the company's property loss was about $200,000. Planters on the larger keys lost their orange groves, pineapple fields, and homes, and in some cases the losses were so complete that the places have been abandoned. Six lives are reported to have been lost on plantations thus destroyed. The storm caught most of the several hundred laborers and mechanics of the railway extension on houseboats and other clumsy craft moored to piling for living quarters. These boats were torn from their moorings and beaten to pieces by the seas. The loss of life among these men was about 135. One hundred and fifty men were picked up at sea on wreckage by steamers bound in and out of the Gulf. One passenger steamer, the *St. Lucie*, an old river packet, was swamped and 23 of the 80 people on board were lost near Elliotts Key.

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The following report of a storm that visited the Nicaragua coast October 9, 1906, has been made by Dr. W. F. Thornton, Bluefields:

Inclosed find my report for October. I add barometer readings for October 9, the day of the storm on this coast. Fortunately Bluefields was but slightly damaged, a few trees uprooted and some corrugated roofing torn off. Beginning twelve miles north, and having a width of twenty to twenty-five miles, the storm swept everything before it. It traveled from east to west and was accompanied by a tidal wave. Some reefs that before the storm were two or three feet below the surface are now four or five feet above. Small cays have disappeared from the surface; especially two small cays (Seal Cays), one having four and the other twelve cocoanut palms, and used as a point by navigators when passing between the mainland and the Corn Islands, can no longer be seen. The tidal wave affected the coast for eighty miles, extending from ten miles north of Bluefields to the north. Its greatest height was fifteen feet. The following are barometer readings made at Bluefields:

| Date. | Hour. | Pressure. | Date. | Hour. | Pressure. |
|---|---|---|---|---|---|
| October 9, | 7 a. m. | 29.91 | October 9, | 8 p. m. | 29.60 |
| | 12 noon | 29.87 | | 9 p. m. | 29.59 |
| | 1 p. m. | 29.85 | | 9:30 p. m. | 29.57 |
| | 2 p. m. | 29.82 | | 10 p. m. | 29.60 |
| | 3 p. m. | 29.78 | October 10, | 1 a. m. | 29.66 |
| | 4 p. m. | 29.72 | | 3 a. m. | 29.70 |
| | 5 p. m. | 29.68 | | 5 a. m. | 29.74 |
| | 6 p. m. | 29.63 | | 7 a. m. | 29.81 |
| | 7 p. m. | 29.62 | | | |

Colon, Panama, is the only station in the southwestern Caribbean Sea that reports by telegraph to the Weather Bureau at

Washington. Barometric pressure began to fall at that station on the 6th and continued to fall until the morning of the 9th, when a reading of 29.72 inches was reported. At 9:30 p. m. of that day the storm center, traveling in a westerly course, struck the Nicaragua coast line north of Bluefields, and did not thereafter appear within the region of telegraphic observation.

Mr. A. J. Mitchell, Observer of the Weather Bureau at Jacksonville, Fla., reports as follows:

It may be appropriate to say that ample warnings were issued in advance of the storm. Special messengers were sent to outlying points, and so far as possible thoro warning was given in Monroe, Dade, and the lower portion of Brevard counties, where the damage was greatest. At Miami many houses were blown down or damaged, and horticultural interests suffered much loss. The losses in and about Miami amounted to about $160,000. The loss of life among laborers extending the Florida East Coast Railway is placed at 124. The men lived in houseboats that were swept out to sea. The islands behind which the boats were anchored had afforded ample protection against previous storms. The stern-wheel steamer *St. Lucie*, used as a transport for the railway company, left Miami about noon of the 17th. The northeast storm warning was flying at that time and messages from the Central Office urged vessels to remain in port. The *St. Lucie* was lost and many of her passengers were drowned, but it may be well to state that the master of the vessel left port without consulting the proper officials of the railway, who always direct that proper precaution be taken on the Weather Bureau warnings.

The American Consul, José de Olivares, at Managua, Nicaragua, under date of October 26, reports:

I have the honor to report that during the interval of two weeks, from October 8 to 22, this entire Consular District was visited by what was probably the severest rainstorm that has ever occurred in this part of the world. In the great valley lying between the two mountain systems here in western Nicaragua, in which are situated Lakes Managua and Nicaragua, the most notable characteristic of the storm was the almost continuous torrential rainfall, which in the rural districts resulted in much damage to public roads, and in the cities and towns was the cause of considerable suffering, by reason of the insufficiency of the houses to resist the ingress of the rain, which literally filtered through the tile roofs and in many instances absolutely flooded the interiors. At the consulate, notwithstanding that it is housed in one of the most substantial structures in the capital, the same conditions obtained, the floors being converted into great pools of water and it being necessary to keep the furniture constantly covered with oilcloths.

Among the poorer classes much misery, attended with a great deal of sickness and an unusual number of deaths, has been one of the most serious results of the storm.

From San Juan del Sur our consular agent reports the same character of weather, which constituted a great obstacle to the commerce and general traffic thereabouts. At Corinto, in addition to the downpour of rain there was experienced an unusually heavy sea, which badly damaged a part of the new dock in process of construction at that port.

But the severest conditions and worst results in this district are reported from our consular agent at Matagalpa, in the northern mountain section of this country. The rainfall thereabouts resulted in a number of serious floods causing extensive damage to the plantations, and washing away the roads and bridges throughout that locality. In several cases tremendous landslides, carrying away whole hillsides, occurred. The crops in general suffered badly, the corn being entirely destroyed in many sections.

Taken together with the disastrous tempest that is reported to have laid waste almost the entire eastern seaboard of this country, the results of the storm in general to Nicaragua are appalling in the extreme.

BOSTON FORECAST DISTRICT.

The weather, generally speaking, was pleasant. The temperatures ranged near the seasonal average, without marked extremes. The precipitation was also somewhat in excess of the normal, altho unevenly distributed over the section. Snow fell to a depth of several inches on the closing days of the month in parts of New Hampshire and Vermont, but elsewhere the precipitation was in the form of rain. During the first week of the month there was an unusual prevalence of fog in coast sections that inconvenienced and greatly delayed shipping. No severe general windstorms swept the coast, altho increasing easterly winds on the 30th and 31st reached strong gale force along the southern coast. Storm warnings were displayed on the 8th, 15th, 18th, 19th, 27th, and 28th. Frost warnings were issued to cranberry growers on the 9th, and were followed by generally killing frosts and freezing weather.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.

Frost warnings were issued on several dates and all were justified, except the one on the 22d, when an area of low pressure developed over the lower Missouri Valley during the succeeding twelve hours, and the high pressure failed to move eastward as was anticipated in the forecast. General frost occurred over the northern portion of the district on the 28th and 31st. Frost did not occur without warnings, except possibly over very limited areas. No cold waves occurred during the month and no warnings were issued. There were no general storms along the west Gulf coast during the month and no warnings were issued.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.

Ideal fall weather prevailed during the month. The temperature was for the most part normal, altho the main event of the month was the unusually early cool wave of the 10–12th, when killing frost occurred generally thruout the district, and freezing temperature in the eastern portion. There were quite heavy flurries of snow over northern and eastern Kentucky the 10th—the earliest snow in this section since the records of the Weather Bureau began. Six general storm disturbances past over or near the district during the month, but the most pronounced one was that of the 26–27th, which was attended by high winds, tho only light showers. Frost warnings were issued on the 1st for light frost in parts of Kentucky; on the 9th for light frosts in both States, and on the 10th for killing frosts for the entire district. These warnings were fully verified, except the one on the 1st.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.

The weather in this district during the month of October was not especially eventful, altho the temperature was below the normal during most of the second decade. Neither were the storms on the Lakes especially severe. Warnings were ordered on the morning of the 8th for a storm which developed over the upper Mississippi Valley, and these warnings were continued at several stations over the 9th. High winds were quite general. Warnings were again ordered on the morning of the 24th for a storm which had moved from the southwest with increasing intensity, and was central on the 24th over Iowa. This storm rapidly crost the Lake region with brisk to high winds and was central on the morning of the 25th in Ontario. Still another storm developed over the Lake region on the 26th and 27th, and by the morning of the 27th had increased greatly in energy, passing rapidly eastward with general high winds. The warnings for the storm were ordered on the 27th.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.

The month was drier and somewhat milder than usual west of the Continental Divide, while an excess of precipitation with mean temperatures below normal was general on the eastern slope. The night of the 19th marked the beginning of the snowstorm which was exceptionally heavy and prolonged on the eastern slope. In southeastern Wyoming and northeastern Colorado the storm was continuous until the night of the 23d. While the accumulated fall was considerable during the first two or three days little or no damage resulted until the 23d, on which date high winds set in early in eastern Wyoming and northeastern Colorado, drifting the snow so badly as to cause a serious blockade on the different railroads. The important phases of this storm were well covered by the forecasts, and on the 21st warnings were issued for the cold wave that visited northern New Mexico. Frosts were frequent during the first and second decades; they were accurately forecast.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.

The month was comparatively free from storms, high winds, or heavy rains. On October 16 a depression of considerable energy appeared on the northern coast, and southeast storm warnings were ordered for Eureka. The storm passed rapidly eastward, influencing only the extreme northern end of California. A sharp fall in temperature occurred in northern Nevada on October 17.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.

As usual at this season of the year a number of low pressure areas made their appearance in British Columbia and moved eastward across the Rocky Mountains. The centers of most of these disturbances were too far north to cause gales and rain in this district, except in its northwest corner, where a few stations reported from one to two inches more than the usual amount of rain. The rainfall was generally deficient in the remaining portion of the district and in its southern portion the deficiency was marked. The principal stormy periods were on the 2d, from the 11th to the 15th, inclusive, and on the 24th and 25th. Frequent light frosts occurred in exposed places, and on the mornings of the 20th, 21st, and 22d frosts were general in western Oregon and western Washington. No gales or frosts occurred without timely warnings having been issued.—*E. A. Beals, District Forecaster.*

## RIVERS AND FLOODS.

Abundant rains thruout the South during the first four or five days of the month brought a general response from the rivers, except those of the extreme southwestern districts, and in many localities flood stages were reached and past. Warnings of stages exceeding 40 feet during the ensuing three or four days were issued on the 1st, for the lower Tombigbee River, and the 40-foot stage was past during the 6th, when a supplementary warning was issued for a further rise to about 45 feet within three or four days. On the 10th a crest stage of 44.5 feet, 9.5 above the flood stage, was reached at Demopolis, Ala.

Warnings of flood stages were issued on the 2d for the lower Tennessee River, and gage heights as follows were recorded: Riverton, Ala., 26.6 feet on the 7th, or 1.6 feet above the flood stage; Johnsonville, Tenn., 25.3 feet on the 9th, or 4.3 feet above the flood stage. Warnings were also issued on the same date for the Ocmulgee and Oconee rivers of Georgia, and in due time moderate flood stages occurred in the Ocmulgee, but not in the Oconee, altho there was a decided rise. On the 3d warnings were issued for the upper James River, and on the 5th a stage of 17.2 feet, 0.8 foot below the flood stage, was reached at Columbia, Va. On the 5th warnings were issued for the flood stage of 24 feet at Camden, S. C., on the Wateree River, and by the morning of the 6th the water had reached a height of 22 feet.

There was a rapid rise in the Alabama River, of which notice was given on the 1st, but flood stages were not quite reached. There was also another in the rivers of southeastern Mississippi for which warnings were issued from the 3d to the 6th as conditions required.

The last general rise occurred from the 19th to the 23d, inclusive. It extended thru nearly all of the rivers east of the Appalachians, and also thru the New-Kanawha watershed of West Virginia. It was caused, primarily, by the heavy rains that fell from the 17th to the 19th, inclusive, and was assisted in the Carolinas by a prolongation of the rains until the 23d. The Potomac River, at Harpers Ferry, W. Va., approached to within 2 feet of the flood stage of 18 feet, altho warnings were not necessary.

The James River was generally above the flood stage, except in the immediate vicinity of Lynchburg, Va., and the first warnings for upper river points were issued on the morning of the 19th. At 6 a. m., of the 20th, warnings were issued for the lower river. These warnings were supplemented by others during the afternoon of the 20th and the morning of the 21st, and the crest stages were as follows: Buchanan, Va., 15.6 feet on the 20th, 3.6 feet above the flood stage; Lynchburg, Va., 14.6 feet on the 20th, 3.4 feet below the flood stage; Columbia, Va., 31.5 feet during the night of the 20th and 21st, 13.5 feet above the flood stage; and Richmond, Va., 18.7 feet on the 22d, 6.7 feet above the flood stage.

The Roanoke flood was more moderate, altho a stage of 35.5 feet, 5.5 feet above the flood stage, was reached on the 23d at Weldon, N. C. Warnings covering this rise were issued on the 21st.

The rise in the Pedee River was not pronounced, altho by the end of the month the stage at Smith Mills, S. C., was 13.6 feet, 2.4 feet below the flood stage. Preliminary warnings were issued on the 20th.

There was a decided flood in the Catawba–Wateree River below the North Carolina line, and on the 21st a crest stage of 28.6 feet, 4.6 feet above the flood stage, was reached at Camden, S. C. Warnings were first issued on the morning of the 19th, when the reports of the heavy rainfalls were received, and again on the 20th for a further rise to 29 feet at Camden, only 0.4 foot higher than the stage actually reached. The rise did not extend over the Congaree watershed to any appreciable extent, nor was that in the Santee of consequence. The latter river had been comparatively high thruout the month, and the late additions from the Wateree had but little effect.

No reports of serious losses or damage to property have been received, and their absence was doubtless due both to the efficiency of the Weather Bureau warnings and to the lateness of the season. Had the same floods occurred a month or two earlier, there would most certainly have been damage to crops that no warnings could have prevented.

The Ohio, Mississippi, and Missouri rivers, and those of the West, did not present any unusual features during the month.

The highest and lowest water, mean stage, and monthly range at 273 river stations are given in Table VI. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.